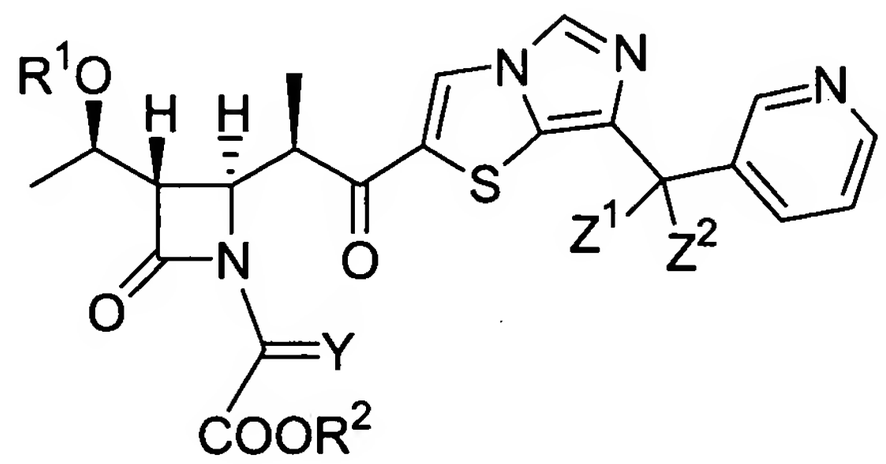
JC17 Rec'd PCT/PTO 10 JUN 2005

AMENDMENTS TO THE CLAIMS

1. (Original) A compound represented by formula (1):



(1)

wherein

R^1 represents a hydrogen atom or a protective group of hydroxyl,

R^2 represents a hydrogen atom, a protective group of carboxyl, or an anion in a carboxylate anion,

Z^1 and Z^2 together represent an oxygen atom or a protective group of carbonyl, or

one of Z^1 and Z^2 represents a hydrogen atom and the other represents hydroxyl or protected hydroxyl,

Y represents an oxygen atom or group $P(R^3)_3$,

wherein R^3s, which may be the same or different, represent

C1-6 alkyl optionally substituted by a halogen atom, or

aryl optionally substituted by a halogen atom or C1-6 alkyl in which the alkyl group may be substituted by a halogen atom.

2. (Original) The compound according to claim 1, wherein Y represents an oxygen atom.

3. (Original) The compound according to claim 1, wherein Y represents group $P(R^3)_3$.

4. (Original) The compound according to claim 3, wherein R^3 represents phenyl.

5. **(Currently amended)** The compound according to ~~**any one of**~~ claim**[[s]]** 1 **[[to 4]]**, wherein R^1 is selected from the group consisting of a hydrogen atom, t-butyldimethylsilyl, trimethylsilyl, and triethylsilyl.

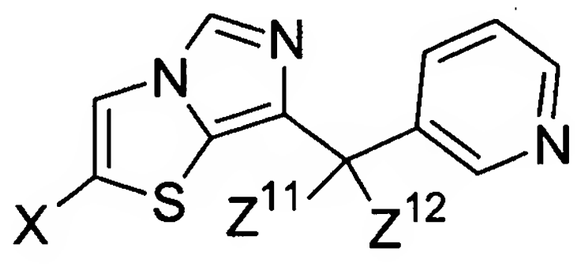
6. **(Currently amended)** The compound according to ~~**any one of claims 1 to 5**~~ **claim 1**, wherein R^2 is selected from the group consisting of a hydrogen atom, an anion in carboxylate anion, 4-nitrobenzyl, 4-methoxybenzyl, diphenylmethyl, allyl, and, t-butyldimethylsilyl.

7. **(Currently amended)** The compound according to ~~**any one of claims 1 to 6**~~ **claim 1**, wherein Z^1 and Z^2 together represent a group selected from the group consisting of an oxygen atom, dimethoxy, diethoxy, and dimethylhydrazone, or

one of Z^1 and Z^2 represents a hydrogen atom and the other represents hydroxyl, or represents hydroxyl protected by a group selected from the group consisting of t-butyldimethylsilyl, trimethylsilyl, and triethylsilyl.

8. (Original) A process for producing a compound represented by formula (1) according to claim 1 wherein Y represents group $P(R^3)_3$, said process comprising the step of

reacting a reaction mixture, prepared by treating a compound of formula (4') with a Grignard reagent, with a compound of formula (5):



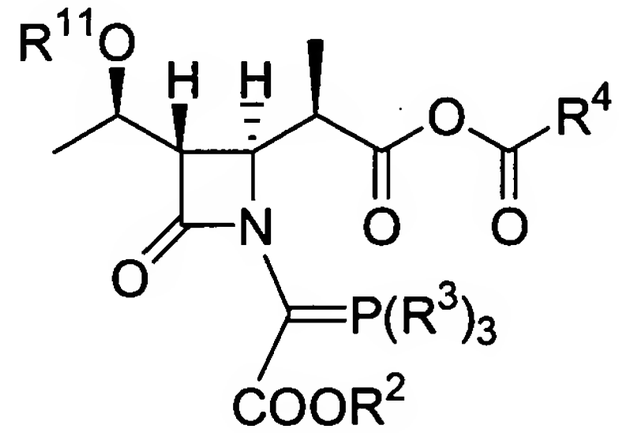
(4')

wherein

Z^{11} and Z^{12} together represent an oxygen atom or a protective group of carbonyl, or

one of Z^{11} and Z^{12} represents a hydrogen atom and the other represents protected hydroxyl, and

X represents a halogen atom; and



(5)

wherein

R^{11} represents a protective group of hydroxyl,

R^2 and R^3 are as defined in formula (1), and

R^4 represents

optionally substituted C1-6 alkyl, or

aryl optionally substituted by a group selected from the group consisting of a halogen atom, optionally substituted C1-6 alkyl, optionally substituted C1-6 alkoxy, and $-NR^5R^6$,

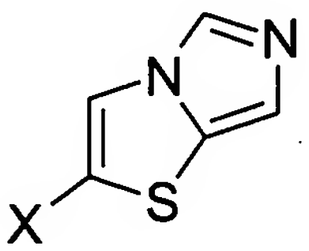
wherein R^5 and R^6, which may be the same or different, represent C1-6 alkyl, or R^5 and R^6 together represent $-(CH_2)_n-$ wherein n is an integer of 2 to 6.

9. (Original) The process according to claim 8, wherein Y in formula (1) represents group $P(C_6H_5)_3$.

10. **(Currently amended)** The process according to claim 8 **[[or 9]]**, wherein said treatment with the Grignard reagent is carried out using an alkylmagnesium bromide as the Grignard reagent in a solvent selected from the group consisting of methylene chloride, ether, tetrahydrofuran, dioxane, benzene, and toluene.

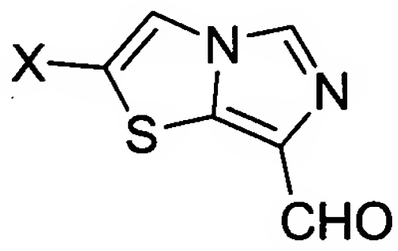
11. (Original) The process according to claim 8, which further comprises preparing the compound of formula (4') by steps (c) and (d):

(c) formylating a compound of formula (14) with a Vilsmeyer complex to give a compound of formula (18):



(14)

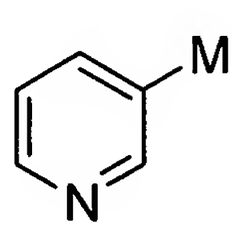
wherein X represents a halogen atom, and



(18)

wherein X represents a halogen atom, and

(d) reacting the compound of formula (18) with a 3-metallopyridine of formula (19) to give a compound of formula (4') in which one of Z^{11} and Z^{12} represents a hydrogen atom and the other represents hydroxyl, and either protecting hydroxyl in this compound, or oxidizing hydroxyl in this compound and protecting carbonyl in the resultant compound, to give the compound of formula (4'):

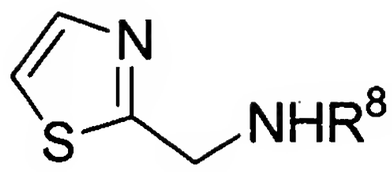


(19)

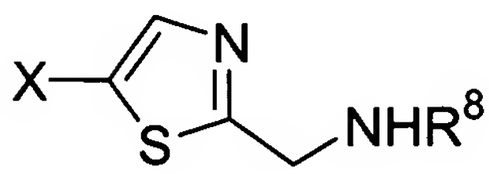
wherein M represents lithium, MgBr, or MgI.

12. (Original) The process according to claim 11, which further comprises preparing the compound of formula (14) by steps (a) and (b):

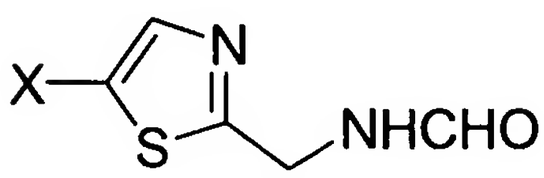
(a) reacting a compound of formula (15) with a halogenating agent to give a compound of formula (16) and formylating the amino group optionally after removing the protective group, to give a compound of formula (17):



(15)



(16)



(17)

wherein

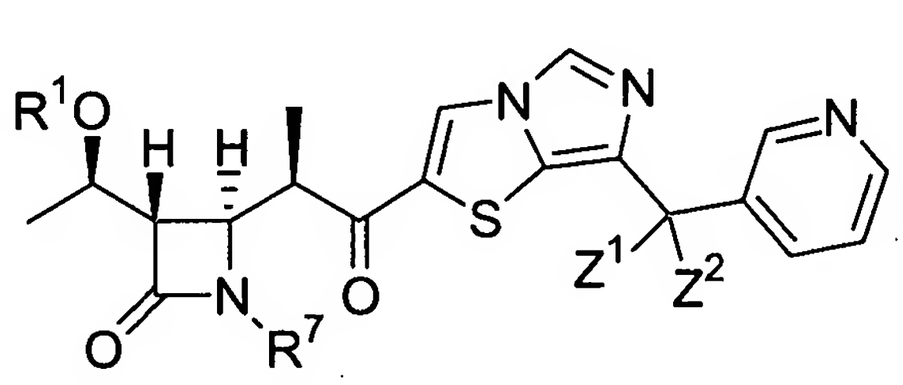
R^8 represents a hydrogen atom, or a protective group of amino and

X represents a halogen atom, and

(b) reacting the compound of formula (17) with a dehydrating agent for cyclization to give a compound of formula (14).

13. (Original) A process for producing a compound represented by formula (1) according to claim 1 wherein Y represents an oxygen atom, said process comprising the step of

reacting a compound of formula (8) with a compound of formula (9) in the presence of a base:



(8)

(9)

wherein

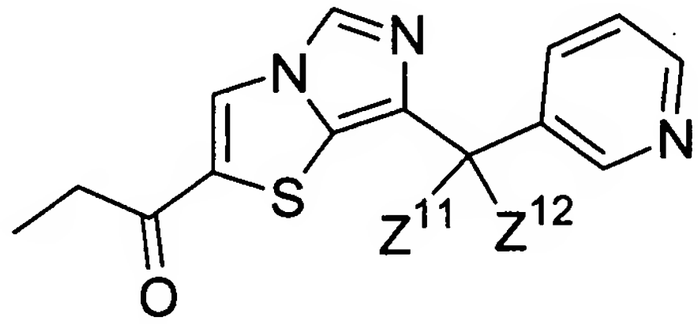
R^7 represents a hydrogen atom, or a protective group of amino,

R^1, R^2, Z^1 and Z^2 are as defined in formula (1), and

L^2 represents a leaving group.

14. (Original) The process according to claim 13, which further comprises preparing the compound of formula (8) by step (f):

(f) reacting a compound, prepared by treating a compound of formula (6') with an alkali metal base, or a base and a monovalent to tetravalent metal compound, with a compound of formula (7), and optionally removing a protective group and/or introducing a protective group and/or conducting oxidization to give a compound of formula (8):

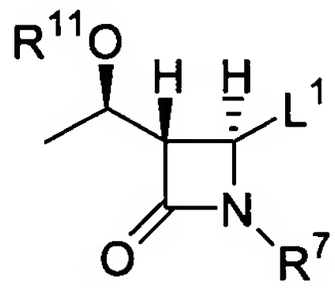


(6')

wherein

Z^{11} and Z^{12} together represent an oxygen atom, or a protective group of carbonyl, or

one of Z^{11} and Z^{12} represents a hydrogen atom and the other represents protected hydroxyl; and



(7)

wherein

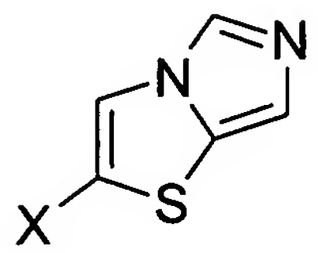
R^{11} represents a protective group of hydroxyl,

R^7 represents a hydrogen atom or a protective group of amino, and

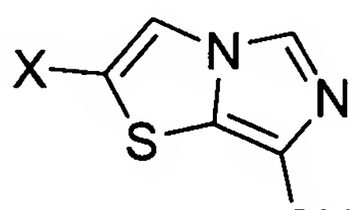
L^1 represents a leaving group.

15. (Original) The process according to claim 14, which further comprises preparing a compound of formula (6') by steps (c), (d) and (e):

(c) formylating a compound of formula (14) with a Vilsmeyer complex to give a compound of formula (18):



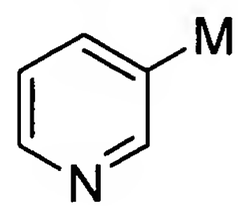
(14)



(18)

wherein X represents a halogen atom,

(d) reacting the compound of formula (18) with a 3-metallopyridine of formula (19) to give a compound of formula (4') wherein one of Z^{11} and Z^{12} represents a hydrogen atom and the other represents hydroxyl, and either protecting hydroxyl in this compound, or oxidizing hydroxyl in this compound and protecting carbonyl in the resultant compound, to give a compound of formula (4'):



(19)

wherein M represents lithium, MgBr, or MgI, and

(e) reacting a compound, prepared by treating the compound of formula (4') with a Grignard reagent, with a propionic acid derivative to give a compound of formula (6').

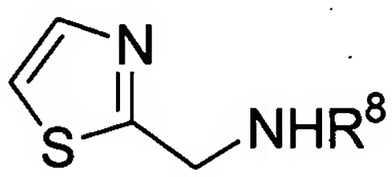
16. (Original) The process according to claim 15, wherein

said Grignard reagent is selected from the group consisting of alkylmagnesium chlorides, alkylmagnesium bromides, alkylmagnesium iodides, and arylmagnesium bromides, and

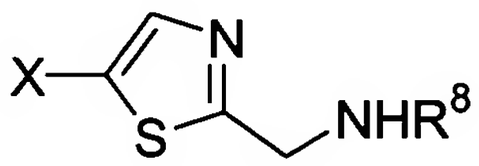
said propionic acid derivative is selected from the group consisting of N-methyl-N-methoxypropionamide, propionic anhydride, propionyl chloride, and propionic acid (pyridin-2-ylthio) ester.

17. **(Currently amended)** The process according to claim 15 **[[or 16]]**, which further comprises preparing a compound of formula (14) by steps (a) and (b):

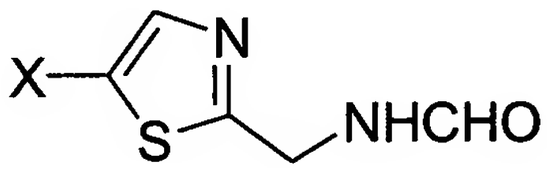
(a) reacting a compound of formula (15) with a halogenating agent to give a compound of formula (16) which, optionally after the removal of a protective group, undergoes formylation of amino to give a compound of formula (17):



(15)



(16)



(17)

wherein

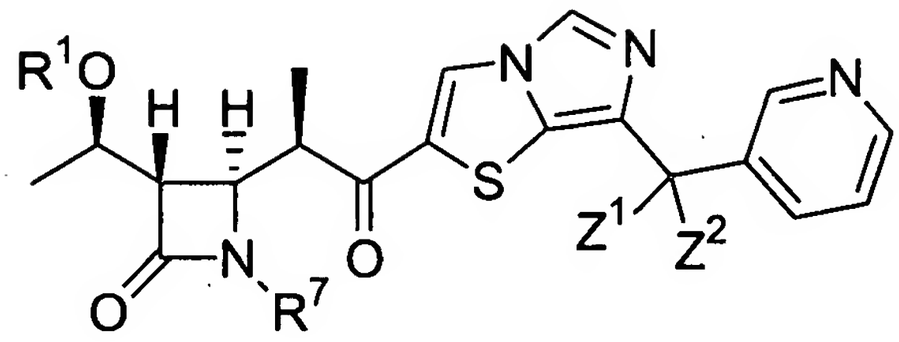
R^8 represents a hydrogen atom, or a protective group of amino, and

X represents a halogen atom, and

(b) reacting the compound of formula (17) with a dehydrating agent for cyclization to give a compound of formula (14).

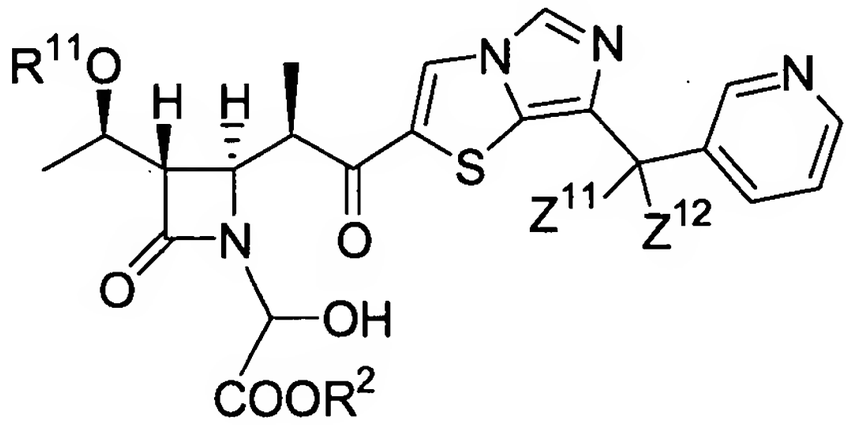
18. (Original) A process for producing a compound represented by formula (1) according to claim 1 wherein Y represents group $P(R^3)_3$, said process comprising the steps of

halogening hydroxyl in a compound of formula (11), prepared by reacting a compound of formula (8) with a compound of formula (10) or its reactive equivalent, with a halogenating agent, and reacting the resultant compound with a compound of formula (13):



(8)

$HC(=O)\text{-}COOR^2$ (10)



(11)

$P(R^3)_3$ (13)

wherein

R^{11} represents a protective group of hydroxyl,

R^1, R^2, and R^3 are as defined in formula (1),

R^7 represents a hydrogen atom,

Z^1 and Z^2 together represent an oxygen atom, or a protective group of carbonyl,

or,

one of Z^1 and Z^2 represents a hydrogen atom and the other represents hydroxyl or protected hydroxyl,

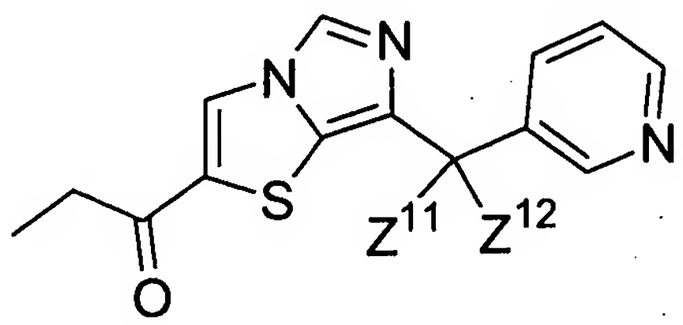
Z^{11} and Z^{12} together represent an oxygen atom, or a protective group of carbonyl, or

one of Z^{11} and Z^{12} represents a hydrogen atom and the other represents protected hydroxyl.

19. (Original) The process according to claim 18, wherein Y in formula (1) represents group $P(C_6H_5)_3$.

20. (Original) The process according to claim 18, which further comprises preparing a compound of formula (8) by step (f):

(f) reacting a compound, prepared by treating a compound of formula (6') with an alkali metal base, or a base and a monovalent to tetravalent metal compound, with a compound of formula (7), and optionally removing a protective group and/or introducing a protective group and/or conducting oxidization to give a compound of formula (8):

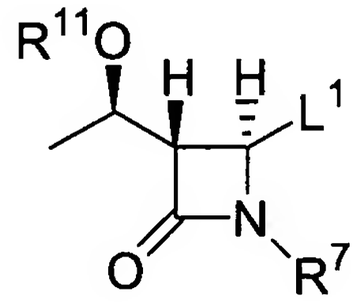


(6')

wherein

Z^{11} and Z^{12} together represent an oxygen atom, or a protective group of carbonyl, or

one of Z^{11} and Z^{12} represents a hydrogen atom and the other represents protected hydroxyl;



(7)

wherein

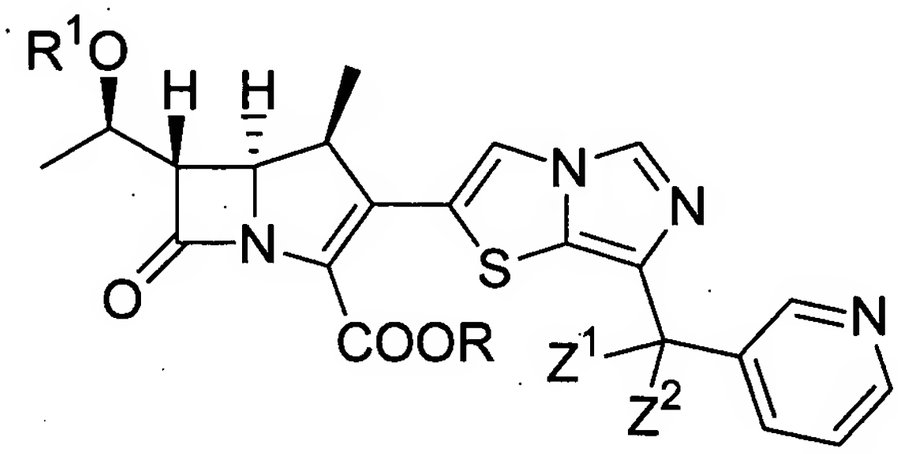
R^{11} represents a protective group of hydroxyl,

R^7 represents a hydrogen atom, or a protective group of amino, and

L^1 represents a leaving group.

21. (Original) A process for producing a compound represented by formula (2), said process comprising the steps of

treating a compound of formula (1) according to claim 1 under conditions, which can form a carbapenem ring, to form a carbapenem ring through a ring-closing reaction and optionally conducting the removal of a protective group and/or oxidation:



(2)

wherein

R^1 represents a hydrogen atom, or represents a protective group of hydroxyl,

R represents a hydrogen atom, a protective group of carboxyl, or an anion in a carboxylate anion,

Z^1 and Z^2 together represent an oxygen atom, or a protective group of carbonyl, or

one of Z^1 and Z^2 represents a hydrogen atom and the other represents hydroxyl or protected hydroxyl.

22. (Original) The process according to claim 21, wherein Y in formula (1) represents an oxygen atom.

23. (Original) The process according to claim 22, wherein the treatment for forming the carbapenem ring is carried out by reacting the compound of formula (1) with a compound of formula (21):

$$P(R^9)_3 \qquad (21)$$

wherein

R^9s, which may be the same or different, represent C1-6 alkyl or C1-6 alkoxy.

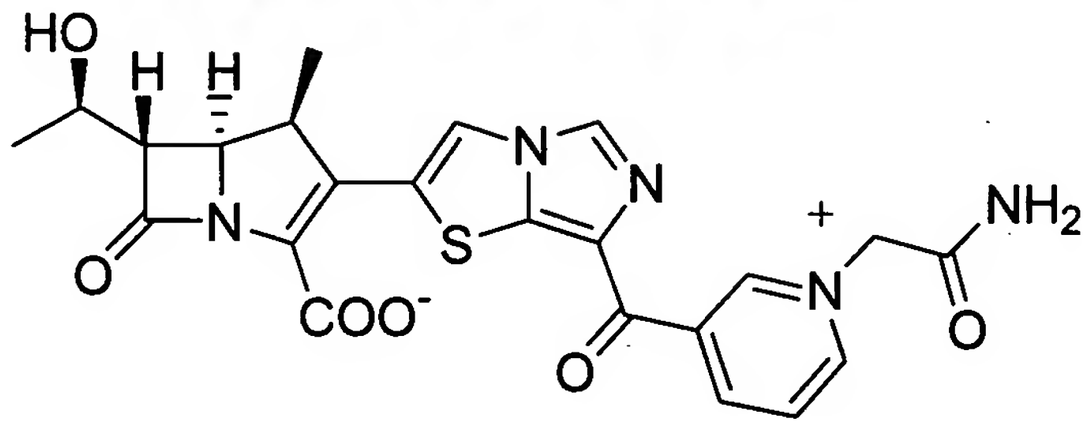
24. (Original) The process according to claim 23, wherein the compound of formula (21) is diethyl methylphosphonite.

25. (Original) The process according to claim 21, wherein Y in formula (1) is group $P(C_6H_5)_3$.

26. (Original) The process according to claim 25, wherein the treatment for forming the carbapenem ring is carried out by eliminating $O=P(R^3)_3$ from the compound of formula (1).

27. **(Currently amended)** A process for producing a compound represented by formula (A), comprising the step of

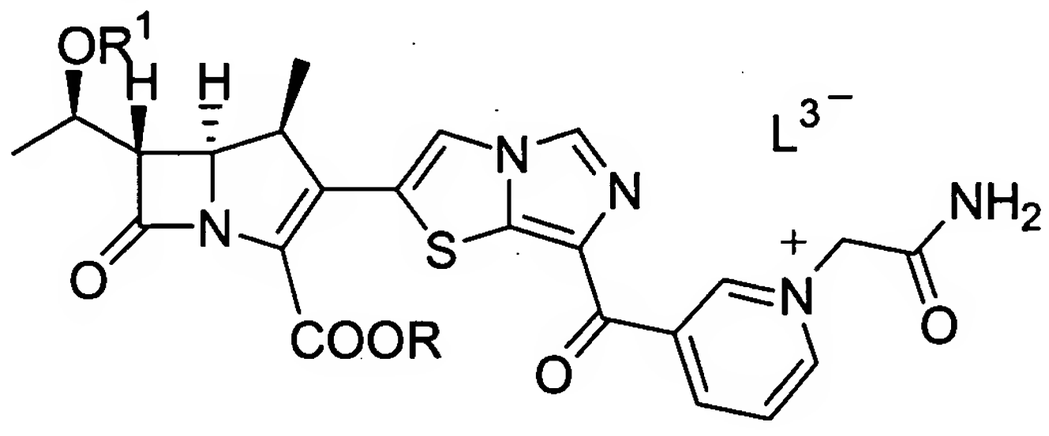
preparing the compound of formula (2) from the compound of formula (1) by a process according to ~~**any one of claims 21 to 26**~~ **claim 21**:



(A)

28. (Original) The process according to claim 27, which further comprises the step of reacting the compound of formula (2) with a compound of formula (iv) to give a compound of formula (3):

$L^3CH_2CONH_2$ (iv)



(3)

wherein

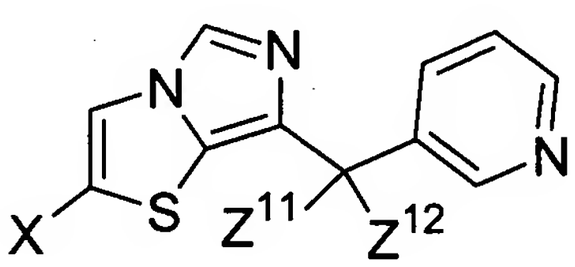
L^3 represents a leaving group,

R^1 represents a hydrogen atom, or represents a protective group of hydroxyl, and

R represents a hydrogen atom, a protective group of carboxyl, or an anion in a carboxylate anion.

29. (Original) The process according to claim 28, which further comprises the step of removing the protective group in the compound of formula (3) by a deprotection reaction to give the compound of formula (A).

30. **(Currently amended)** The process according to **claim 27** ~~**any one of claims 27 to 29, which**~~ further comprises the step of preparing the compound of formula (1) by ~~**the process according to any one of claims 8 to 20**~~ **reacting a reaction mixture, prepared by treating a compound of formula (4') with a Grignard reagent, with a compound of formula (5),**



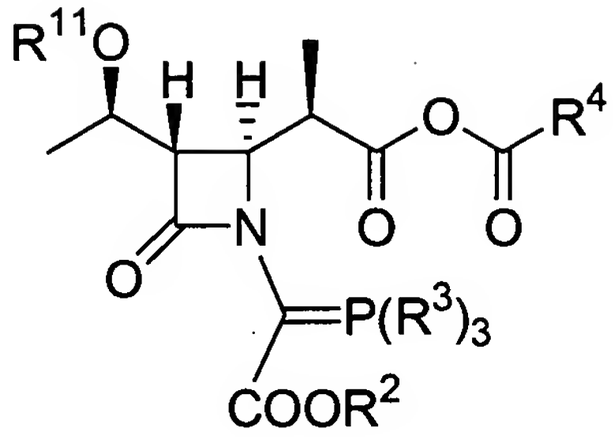
(4')

wherein in formula (4')

Z^{11} and Z^{12} together represent an oxygen atom or a protective group of carbonyl, or

one of Z^{11} and Z^{12} represents a hydrogen atom and the other represents protected hydroxyl, and

X represents a halogen atom; and



(5)

wherein in formula (5)

R^{11} represents a protective group of hydroxyl,

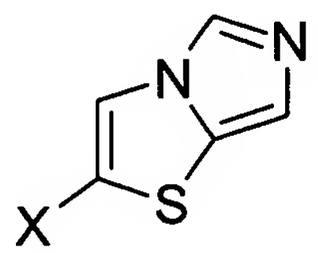
R^2 and R^3 are as defined in formula (1), and

R^4 represents

optionally substituted C1-6 alkyl, or

aryl optionally substituted by a group selected from the group consisting of a halogen atom, optionally substituted C1-6 alkyl, optionally substituted C1-6 alkoxy, and $-NR^5R^6$, wherein R^5 and R^6, which may be the same or different, represent C1-6 alkyl, or R^5 and R^6 together represent $-(CH_2)_n-$, wherein n is an integer of 2 to 6.

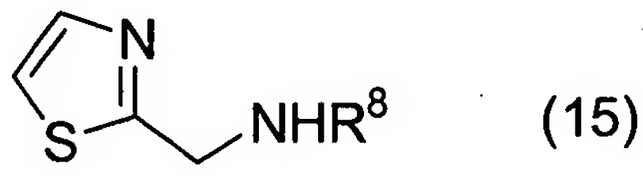
31. (Original) A process for producing a compound represented by formula (14), comprising steps (a) and (b):



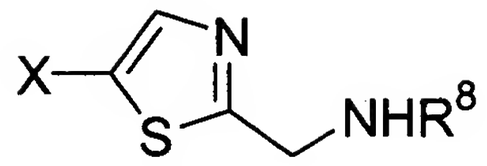
(14)

wherein X represents a halogen atom,

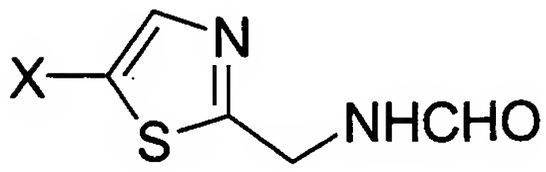
(a) reacting a compound of formula (15) with a halogenating agent to give a compound of formula (16) which, optionally after the removal of a protective group, undergoes formylation of amino to give a compound of formula (17):



(15)



(16)



(17)

wherein

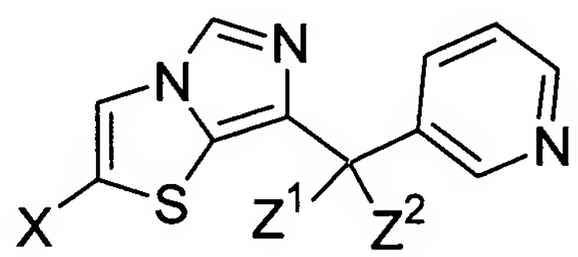
R^8 represents a hydrogen atom, or a protective group of amino, and

X represents a halogen atom, and

(b) reacting the compound of formula (17) with a dehydrating agent for cyclization to give a compound of formula (14).

32. (Original) The process according to claim 31, wherein X represents a bromine atom.

33. (Original) A compound represented by formula (4):



(4)

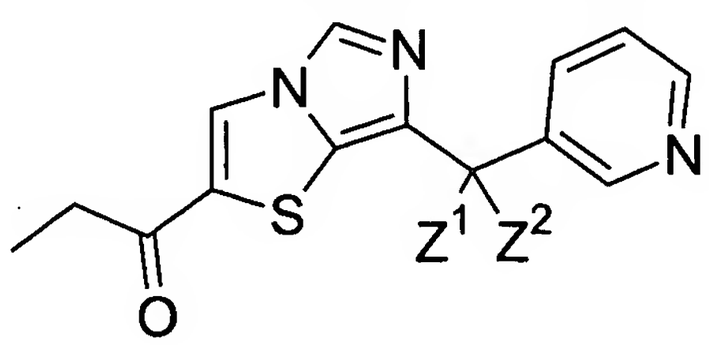
wherein

Z^1 and Z^2 together represent an oxygen atom, or a protective group of carbonyl, or

one of Z^1 and Z^2 represents a hydrogen atom and the other represents hydroxyl or protected hydroxyl, and

X represents a halogen atom.

34. (Original) A compound represented by formula (6):



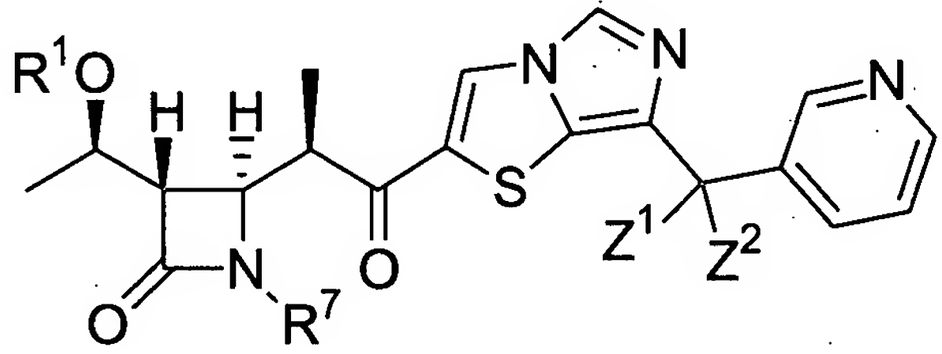
(6)

wherein

Z^1 and Z^2 together represent an oxygen atom, or a protective group of carbonyl, or

one of Z^1 and Z^2 represents a hydrogen atom and the other represents hydroxyl or protected hydroxyl.

35. (Original) A compound represented by formula (8):



(8)

wherein

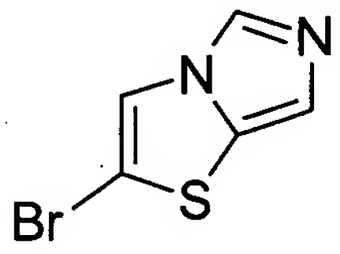
R^1 represents a hydrogen atom, or represents a protective group of hydroxyl,

Z^1 and Z^2 together represent an oxygen atom, or a protective group of carbonyl, or

one of Z^1 and Z^2 represents a hydrogen atom and the other represents hydroxyl or protected hydroxyl, and

R^7 represents a hydrogen atom, or a protective group of amino.

36. (Original) A compound represented by formula (14a):



(14a)

37. **(Currently amended)** **A method of producing an antimicrobial agent, wherein the** ~~**Use of a**~~ compound according to claim 1**[,]** **is used** as a synthetic intermediate for the production of **[[an]]** **the** antimicrobial agent.